

**PHYTOTOXICOLOGY SURVEY REPORT:
THE VICTORIA HOSPITAL
ENERGY FROM WASTE (EFW) POWER
PLANT - LONDON, 1991 AND 1992**

JULY 1994

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**Ministry of
Environment
and Energy**

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PHYTOTOXICOLOGY SURVEY REPORT
THE VICTORIA HOSPITAL
ENERGY FROM WASTE (EFW) POWER PLANT - LONDON
1991 AND 1992

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Report No: SDB-011-3512-93

ABSTRACT

This report summarizes environmental sampling results for 1991 and 1992. Tree foliage was collected from 19 sites in the summer of both years and analysed for 18 inorganic elements. Surface soil (0-5 cm) was collected from the same sites and analyzed for the same elements in 1991 only. The data indicate that the concentrations of the majority of elements in soil and vegetation (manganese and zinc excepted) during 1991 and 1992 sampling seasons were well within the range considered normal for an urban area. In addition, there was no consistent trend toward increased concentration of elements in plots near and/or downwind of the facility. These data are consistent with previous post-operational studies around the facility. Slightly elevated mercury concentrations in soil at some locations, relative to earlier post-operational studies, could not be attributed to the incinerator.

1.0 BACKGROUND AND INTRODUCTION

The Victoria Hospital Corporation and the City of London constructed an Energy-From-Waste incinerator (EFW) facility that went into operation in London, Ontario in August, 1987. Residential garbage and sewage sludge were to be the primary fuels of the new facility. When the facility was constructed it contained three incinerators designed for the incineration of residential garbage only. One incinerator has since been temporarily closed while the remaining two operate at varying capacities.

The EFW facility was constructed on the south side of Commissioners Road almost directly across from the main hospital. The land to the south of Commissioners Road is part the Westminster campus and constitutes a 100 ha parcel known as the "South Campus". The campus is relatively undeveloped and contains Saunders Pond and other small lakes, which are part of a conservation area known as Westminster Ponds/Pond Mills Conservation Area (WPPMCA). Park land (consisting of wooded areas and open fields) and commercial strips provide a buffer of 0.5 to 2 km between the EFW facility and the residential communities that surround the Westminster campus.

The proposal to build an EFW facility in proximity to residential areas and a conservation area was quite controversial and was reviewed by the Consolidated Joint Board (comprising the Environmental Assessment Board and the Ontario Municipal Board) under the Consolidated Hearings Act. Following public hearings, the *Reasons for Decision* of the Board were published and contained the various terms and conditions of approval to proceed with the development of the project^{1,2}. Included in these terms and conditions were a number of required undertakings of the Ministry of the Environment (now the Ministry of Environment and Energy - MOEE). These undertakings included both pre- and post-operational surveys of ambient air quality in the vicinity of the EFW^{4,6} and of vegetation and soil in the WPPMCA.

Studies of the terrestrial environment around the EFW facility were and are currently being conducted by the Phytotoxicology Section of the Standards Development Branch (previously of the Air Resources Branch). The Section has been involved in soil and vegetation studies in the vicinity of the EFW facility since 1982 (i.e., 5 years prior to the commencement of operations).

Formal pre-operational studies on soil and vegetation were conducted in the vicinity of Victoria Hospital in 1984, 1986 and 1987. Summaries of these initial activities are included in published reports^{5,10}. Chemical analysis of soil and vegetation collected from the sampling network in these sample years indicated that for the majority of elements in soil and vegetation the concentrations around the EFW incinerator were well within the range considered normal for an urban area¹⁰. In addition, there were no consistent trends toward increased concentration of elements in plots near and/or downwind of the EFW facility subsequent to commencement of operations. Although post-operational moss bag studies were not conclusive, the data suggested that concentrations of inorganic elements in the incinerator plume were not sufficient to result in downwind moss bag concentrations exceeding the urban Upper Limit of Normal (ULN) Guidelines⁹.

This report outlines the results of vegetation and soil surveys conducted both within the WPPMCA and in the residential communities around the EFW facility in 1991 and 1992.

2.0 METHODOLOGY

Meteorological Data

Seasonal wind data were obtained from Environment Canada (London Airport) for the period 1955 to 1980³.

Vegetation and Soil Surveys

Silver maple foliage collections were conducted in the vicinity of the EFW incinerator by J. Craig Kinch in the late summers of 1991 and 1992 at each of nineteen (19) sampling stations. The majority of sampling stations were maintained from the 1989 survey with some minor modifications (see attached figure). Because the 1991 and 1992 surveys were a scaled-down version of previous, more extensive studies, the sample site numbers start at 42 and are not consecutive. The site numbers have not been re-numbered, so that data in this report are directly comparable to sample sites with the same numbers from previous reports.

Vegetation samples were collected in duplicate at each site from the mid-crown of the established sample tree on the side of the crown facing the source. Soil samples were also collected from each sample station in 1991. Soil samples (0-5 cm) were collected in duplicate from a 100 m² area at each site. Each sample consisted of a minimum of 50 individual cores collected from random locations within the sample area. Samples were collected using a stainless steel corer. Soil samples were not collected in 1992, but will be collected periodically in the future if the survey is continued.

The vegetation samples were oven-dried, ground in a Wiley-mill and stored in glass bottles. Soil samples were air-dried, pulverized to pass through a 60 mesh sieve and also stored in glass bottles. The prepared samples were then forwarded to the MOEE laboratory in Etobicoke for chemical analyses. Samples were analyzed for 18 inorganic elements, as outlined in Tables 1 through 3.

The chemistry of vegetation and soils was compared to the MOEE ULN contaminant guidelines to assess the degree of contamination around the facility⁹. The ULNs represent the maximum expected concentrations in the absence of a point source of air pollution (see Appendix).

3.0 RESULTS AND DISCUSSION

The wind data collected by Environment Canada indicates a strong tendency toward south, southwesterly, west and northwesterly winds during the growing season. Winds from the east, possibly associated with weather disturbances, were also strongly represented. This data, and the results of early modelling efforts to predict sulphur dioxide deposition associated with the EFW facility, indicate that stations located to the west and east of the incinerator at a distance of at least 500 m (i.e., in the stack shadow), will be the stations most likely impacted.

The analytical results for vegetation and soils are presented in Tables 1 to 3. The data indicate that the concentrations in plant tissue and soils around the incinerator were, with few exceptions, well within the range considered normal for an urban area. In addition, there was no consistent trend toward increased concentration of elements in plots near and/or downwind of the facility. These results are consistent with the results of earlier post-operational surveys¹⁰ and ambient air quality studies^{7,8}.

There were fewer exceedences of the ULNs in 1991 and 1992 than in previous post-operational periods. The ULNs were only exceeded for manganese in foliage and zinc in soil. Four (4) sites had foliar manganese concentrations that exceeded the ULN in 1991 while 2 sites exceeded the ULN in 1992. Sites 42 and 56 exceeded the ULN for manganese in both sample years. The ULN for zinc in soil was exceeded in soil at one location in 1991. As in earlier post-operational studies, there were no elements for which the ULNs were exceeded for both soil and vegetation. In addition, concentrations of elements at stations near to the facility and/or those located in the theoretical path of the plume were not consistently elevated relative to those distant from the facility or in a direction less likely (based on prevailing wind directions and emissions modeling) to be impacted by the plume.

There were occasional cases where foliage and/or soil concentrations for specific elements were slightly elevated relative to other surrounding stations, although not above the ULN guidelines. Of particular interest are mercury concentrations in soil collected at Stations 56, 57, 60 and 65 in 1991 with mercury concentrations of 0.17, 0.18, 0.32 and 0.13 ug/g, respectively. The latter three stations are in close proximity to the plant and the mercury concentrations are higher than those found in soil in 1989 and earlier. There were, however, many other stations in close proximity to the plant and in the theoretical areas of maximum impact of the plume that did not have elevated mercury concentrations in soils. In addition, Station 56 is distant (approximately 8 km) and upwind from the EFW incinerator. While these elevations could not be attributed to the EFW plant, they may be worthy of periodic monitoring. Correspondingly elevated mercury concentrations were not found in foliar samples collected in either 1991 or 1992 even though ambient mercury is readily absorbed by tree foliage. While mercury concentrations tended to be lower on average in earlier studies, especially in soil, concentrations in foliage and soil were also occasionally elevated in previous post-operational studies.

4.0 CONCLUSIONS

The data indicate that the concentrations of the majority of elements in soil and vegetation (manganese and zinc excepted) during 1991 and 1992 were well within the range considered normal for an urban area. In addition, there was no consistent trend toward increased concentration of elements in plots near and/or downwind of the facility. These data are consistent with previous post-operational studies around the facility. Slightly elevated mercury concentrations in soil at some locations, relative to earlier post-operational studies, could not be attributed to the incinerator. These data indicate that emissions from the EFW facility have had no measurable impact on the terrestrial environment.

5.0 REFERENCES

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**Figure 1: Victoria Hospital Survey
Vegetation and Soil Collection Stations**

Victoria Hospital Incinerator Vegetation and Soil Stations

Scale 1:50 000 Échelle
Miles 1 2 3
Metres 1000 2000 3000 4000

Control Site
8 km
Plot 62

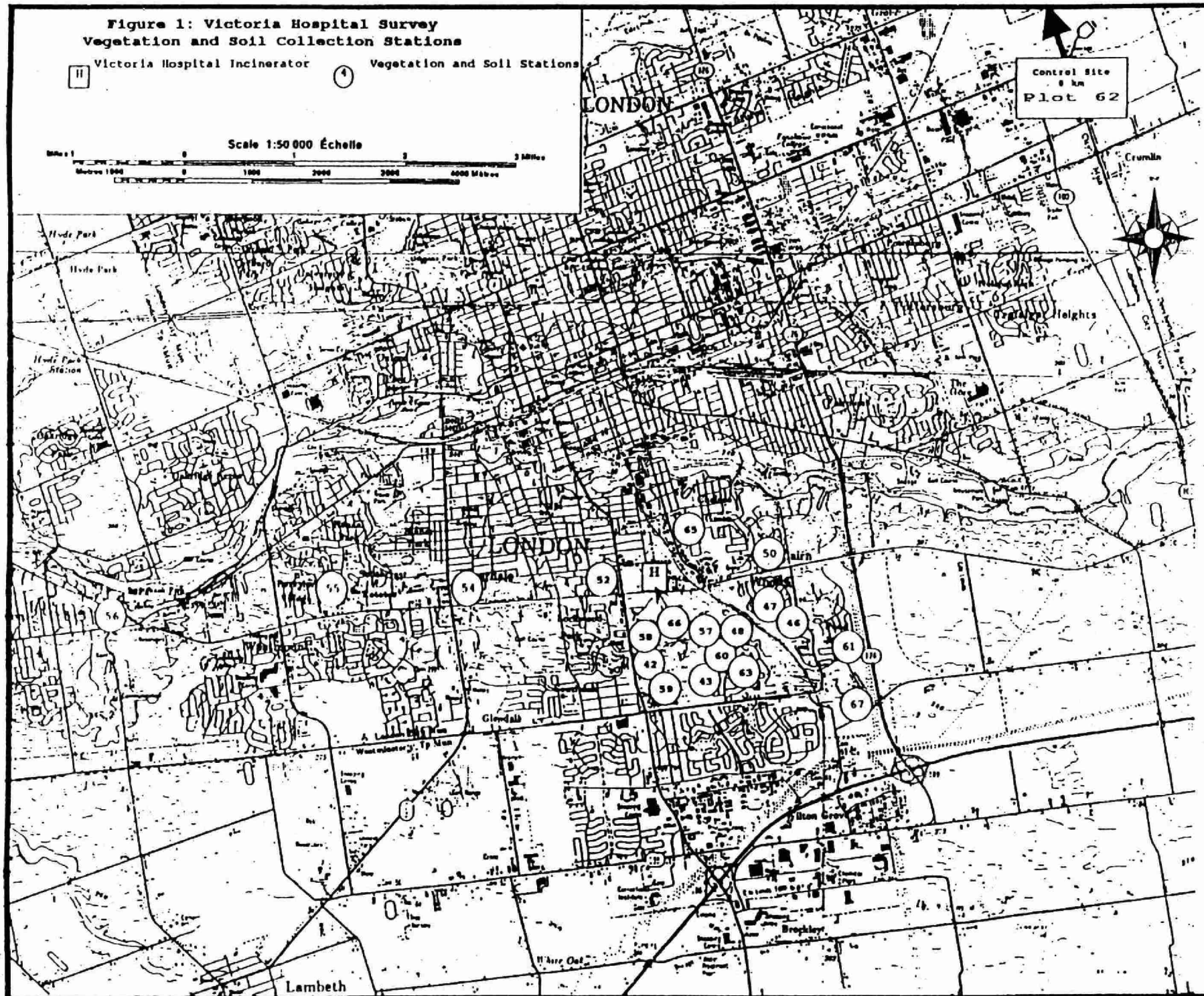


Table 1: Concentrations of inorganic elements (ug/g dry weight, mean of replicate samples) in foliage collected in the vicinity of the Victoria Hospital Energy from Waste (EFW) Incinerator, 1991.

Site	Cu	Ni	Pb	Zn	Fe	Mn	Al	As	Cd	Co	Cr	Hg	Mo	Na	Sb	Se	Sr	V
42	3.9	DL	DL	38	600	<u>130</u>	49	0.94T	DL	DL	DL	DL	DL	85	DL	0.25	22	DL
43	3.7	DL	DL	32	120	41	30	DL	DL	DL	DL	0.04T	<0.2T	14	DL	DL	20	DL
47	3.3	DL	DL	34	130	71	89	DL	DL	DL	DL	DL	DL	14	DL	DL	24	DL
48	2.5	DL	DL	15	110	<u>270</u>	52	DL	DL	DL	DL	0.08	DL	14	DL	DL	25	DL
50	6.3	0.6T	1.4T	42	210	36	130	DL	DL	DL	1.0T	0.04	DL	64	DL	DL	26	DL
52	1.5T	DL	0.8T	36	120	34	56	DL	DL	DL	DL	0.02T	DL	29	DL	DL	19	DL
54	4.5	DL	DL	16	170	25	83	DL	DL	DL	DL	DL	DL	103	DL	DL	26	DL
55	3.1	DL	DL	35	160	48	89	DL	DL	DL	1.1T	DL	DL	182	DL	DL	23	DL
56	3.6	DL	DL	28	110	<u>110</u>	53	DL	DL	DL	DL	DL	DL	17	DL	DL	26	DL
57	12	DL	DL	24	97	<u>170</u>	28	DL	0.22T	DL	DL	0.05	DL	7<T	DL	DL	17	DL
58	5.2	DL	0.5T	25	81	39	43	DL	DL	DL	DL	0.06	<0.2T	21	DL	DL	13	DL
59	4.1	DL	DL	20	73	16	33	DL	DL	DL	DL	DL	DL	17	DL	DL	13	DL
60	4.0	DL	0.7T	15	69	54	34	DL	DL	DL	DL	0.06	DL	11	DL	DL	9.3	DL
61	3.0	DL	DL	22	110	64	38	DL	DL	DL	DL	DL	DL	19	DL	DL	23	DL
62	7.2	DL	1.5T	33	150	71	120	DL	DL	DL	DL	DL	DL	40	DL	DL	18	DL
63	4.4	DL	0.9T	25	170	51	71	DL	DL	DL	DL	0.03T	DL	15	DL	DL	9.8	DL
65	4.7	DL	DL	22	85	46	42	DL	DL	DL	DL	0.06	DL	13	DL	0.24T	22	DL
66	6.1	0.8	DL	26	96	40	51	DL	DL	DL	1.1T	0.03T	DL	23	DL	DL	14	DL
67	6.2	DL	DL	18	170	97	60	DL	DL	DL	DL	0.02T	DL	26	DL	DL	13	DL
ULN	20	7	60	250 ¹	1000	100	500 ¹	2	2	2 ¹	8	0.3	1.5	350	0.5 ²	0.7	NG	5 ¹

- ¹ Rural results higher than urban results - urban guideline based on rural results.
² Provisional guideline estimated from range of results, pending additional data.
 NG No guideline currently available.
 T A measurable trace amount. Interpret with caution.
 DL Less than analytical detection limit.
 ULN Upper Limit of Normal Phytotoxicology guideline for urban tree foliage (see Appendix).

Table 2: Concentrations of inorganic elements (ug/g dry weight, mean of replicate samples) in foliage collected in the vicinity of the Victoria Hospital Energy from Waste (EFW) Incinerator, 1992.

Site	Cu	Ni	Pb	Zn	Fe	Mn	Al	As	Cd	Co	Cr	Hg	Mo	Na	Sb	Se	Sr	V
42	2.1T	DL	DL	23	160	<u>140</u>	38	0.6T	0.11T	DL	DL	0.04T	DL	48	DL	DL	25	DL
43	6.1	DL	DL	35	77	36	26	DL	DL	DL	DL	0.05T	DL	8	DL	DL	11	DL
47	3.8	DL	DL	34	83	95	42	DL	DL	0.2T	DL	0.09	DL	18	DL	DL	23	DL
48	5.2	DL	DL	18	86	<u>81</u>	35	DL	DL	DL	DL	0.07	DL	18	DL	DL	10.4	DL
50	7.5	DL	DL	32	120	37	64	DL	0.18T	DL	DL	0.07	DL	84	DL	DL	32	DL
52	5.3	DL	0.8T	46	86	49	35	DL	DL	DL	DL	0.04T	DL	23	DL	DL	22	DL
54	4.4	DL	1.7T	18	140	56	72	DL	0.13T	DL	DL	0.04T	DL	130	DL	DL	34	DL
55	6.0	DL	1.8T	43	220	38	99	DL	0.14T	DL	0.8T	0.06	DL	44	DL	DL	32	DL
56	6.0	DL	0.8T	25	150	<u>104</u>	77	DL	0.18T	DL	DL	0.03T	DL	10T	DL	DL	29	DL
57	4.9	DL	DL	27	54	<u>41</u>	23	DL	DL	DL	DL	0.06	DL	8T	DL	DL	12	DL
58	5.4	DL	DL	24	57	43	28	DL	0.13T	DL	DL	0.05T	DL	30	DL	DL	12.4	DL
59	8.3	DL	DL	21	77	22	24T	DL	0.14T	DL	DL	0.03T	DL	27	DL	DL	15	DL
60	4.2	DL	DL	39	150	140	38	0.49T	DL	DL	DL	0.05T	DL	40	DL	DL	22	DL
61	5.6	DL	DL	24	90	72	27	DL	0.22T	DL	DL	0.06	DL	13	DL	DL	21	DL
62	5.0	DL	DL	29	95	67	65	DL	DL	DL	DL	0.03T	0.2T	41	DL	DL	18	DL
63	5.4	DL	DL	17	120	110	41	DL	DL	DL	DL	0.06	DL	14	DL	DL	12	DL
65	5.1	DL	DL	21	61	38	25T	DL	DL	DL	DL	0.11	DL	14	DL	DL	18	DL
66	8.3	0.6T	DL	40	110	28	43	DL	DL	DL	0.7T	0.05T	DL	20	DL	DL	7.6	DL
67	6.0	DL	DL	21	91	62	30	DL	0.22T	DL	DL	0.04T	DL	9T	DL	DL	21	DL
ULN	20	7	60	250 ¹	1000	100	500 ¹	2	2	2 ¹	8	0.3	1.5	350	0.5 ²	0.7	NG	5 ¹

- ¹ Rural results higher than urban results - urban guideline based on rural results.
² Provisional guideline estimated from range of results, pending additional data.
 NG No guideline currently available.
 T A measurable trace amount. Interpret with caution.
 DL Less than analytical detection limit.
 ULN Upper Limit of Normal Phytotoxicology guideline for urban tree foliage (see Appendix).

Table 3: Concentrations of inorganic elements (ug/g dry weight, mean of replicate samples) in soil (0-5 cm) collected in the vicinity of Victoria Hospital Energy from Waste (EFW) Incinerator, 1991.

Site	Cu	Ni	Pb	Zn	Fe	Mn	Al	As	Cd	Co	Cr	Hg	Mo	Na	Se	Sr	V
42	18	16	23	49	12000	410	9800	2.5	0.61	5.5	17	0.02 T	DL	180	DL	71	27
43	33	18	26	56	15000	410	14000	3.2	0.53	5.9	21	0.04 T	DL	140	0.28 T	63	33
47	29	22	22	<u>580</u>	22000	500	21000	4.3	1.0	8.4	29	0.04 T	DL	140	0.54 T	28	42
48	26	19	32	78	20000	570	1800	4.5	0.64	10.4	26	0.07	DL	82	0.51 T	17	38
50	32	21	36	85	19000	490	17000	4.5	1.2	7.9	25	0.04 T	DL	170	0.47 T	52	36
52	20	14	92	84	13000	480	11000	3.4	0.87	4.6	20	0.03 T	DL	160	0.27 T	32	27
54	16	13	10	45	13000	330	13000	2.9	0.69	4.7	19	0.03 T	DL	160	0.43 T	30	30
55	18	14	110	65	11000	330	830	3.9	0.77	3.9	17	0.04 T	DL	170	DL	69	23
56	20	13	75	88	17000	580	11000	3.3	0.76	4.7	21	0.17	DL	120	0.28 T	26	36
57	37	21	59	95	14000	190	24000	3.4	1.4	6.8	28	0.18	0.4 T	72	1.0 T	27	41
58	13	5	18	41	11000	240	9200	2.0	0.43	3.9	16	0.03 T	DL	90	0.26 T	19	27
59	50	28	300	210	12000	370	7800	3.0	1.7	3.8	25	0.07	DL	570	0.41 T	81	39
60	45	12	230	90	5200	110	4900	4.6	0.94	2.1	8	0.32	0.3 T	88	1.4	33	13
61	35	17	16	78	16000	360	14000	3.7	0.99	6.1	21	0.05 T	DL	240	0.61 T	43	31
62	17	15	20	59	16000	560	14000	4.2	0.80	6.6	20	0.04 T	DL	98	0.41 T	18	32
63	25	17	19	60	17000	460	15000	3.4	0.67	7.4	24	0.05 T	DL	84	0.38 T	19	33
65	25	18	79	87	14000	400	9500	2.9	1.3	4.5	32	0.13	DL	140	0.34 T	31	29
66	19	18	32	66	17000	530	14000	4.0	0.86	6.6	22	0.04 T	DL	110	0.40 T	20	32
67	32	14	15	86	6800	200	6500	2.4	0.57	2.5	12	0.03 T	DL	160	1.20	99	18
ULN	100	60	500	500	35000	700	NG	20	4	25	50	0.5	3	NG	2	NG	70

NG No guideline currently available.
 T A measurable trace amount. Interpret with caution.
 DL Less than analytical detection limit.
 ULN Upper Limit of Normal Phytotoxicology guideline for urban tree foliage (see Appendix).

6.0 APPENDIX

Derivation and Significance of the MOE Phytotoxicology "Upper Limits of Normal" Contaminant Guidelines.

The MOE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a point source of pollution. Urban ULN guidelines are based on samples collected from developed urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (ref: Ontario Ministry of the Environment 1983, Phytotoxicology Field Investigation Manual). Chemical analyses were conducted by the MOE Laboratory Services Branch.

The ULN is the arithmetic mean, plus three standard deviations of the mean, of the suitable background data. This represents 99% of the sample population. This means that for every 100 samples which have not been exposed to a point source of pollution, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.



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